18 Fog harvesting: Chile

Background and justification

The environment of much of Chile is arid and fragile. Although the country is rich in such valuable minerals as copper, silver, gold, iron and nitrates, they have often been exploited to exhaustion, leaving behind degraded environments and abandoned towns and cities. Marine fisheries have also been over-exploited, leading to the abandonment of coastal settlements. Along with the environmental degradation, people who have lost their source of livelihood are forced to move away, often ending up in the suburbs and slums of large cities where the quality of life is low.

One solution to this problem is to promote sustainable rural development that is not dependent on any one resource. However, the country's chronic shortage of water makes this very difficult.

To counter this situation, scientists in Chile and several other developing countries are experimenting with an often-overlooked but significant source of water in dry areas: fog.

Fog is made up of very small droplets of water that are too light to fall but that gather on the surfaces of plants, rocks and soil. In nature, the presence of fog makes it possible for plants to survive in so-called fog oases, that is, areas with only a few

millimetres of rain a year. The water harvested when special fog collectors are used to extract fog from the atmosphere can be enough to supply the domestic needs of towns with more than 500 inhabitants, provide irrigation for agriculture and forestry, and help to regenerate deteriorated ecosystems.

Description

Fog is harvested by using fog collector devices (FCDs), which usually take the form of a fine mesh net, that trap droplets of fog. As these droplets coalesce into larger drops, they eventually drip into receptacles or pipelines. In order to make one drop of water about the size of a match head, some 10 million fog droplets must be intercepted by an FCD.

The amount of water collected by an array of FCDs depends on their location (as fog tends to form at high altitudes where the terrain might not be suitable for accommodating many FCDs) and the wind speed, with average speeds of six to eight metres per second being the most efficient.

The world's first and largest project to use fog as a community water supply was the Camanchaca project in Chile, which was started in 1987 with financing from the International Development Research Center (IDRC) of Canada and input from the National Forestry Corporation (CONAF), the Pontifical Catholic University of Chile and the University of Chile. This project proved that fog can be harvested in sufficient quantities even in arid areas.

The project community, La Serena, is a fishing village that relied on a water supply of 14 litres per person per day being trucked in by tanker once or twice a week. Under the project, 100 large (48 square metres) FCDs were installed in the El Tofo mountains at an altitude of 750 metres above sea level, where they collected 3 litres of water per square metre per day, producing a daily average of almost 15,000 litres of high-quality water.

The system was inaugurated in 1992, when a pipeline was laid to carry the water to La Serena, doubling the village's water supply and improving living standards and sanitary conditions. People were able to grow fruit and vegetables on a specially established four-hectare plot, while an area similar in size was developed for forestry. As a result, people who had left the village and moved to the city returned, and the population of La Serena increased from 300 in 1992 to more than 500 in 1999, even reaching 2,000 in the summer months.

However, since 2002 and the completion of the IDRC project, the FCDs in the El Tofo mountains and the water pipeline to La Serena have fallen into disrepair. In early 2002, for example, there were about 25 functional fog collectors, but there were none by 2003. Water is once again being ferried to the town by truck and the local people and politicians are asking for a pipeline or a desalination plant, with a cost of up to US$1 million for the installation alone—a cost that can

be justified only if the FCDs are not in operation. Even so, the achievement of providing water from fog to a village in a desert for 10 years is remarkable.

A second project, in the fog oasis of Alto Patache, in the Tarapacá region of Chile, between Pisagua and the Loa River, was started in 1997 with funding from the Chile National Commission for Scientific and Technological Research (CONICYT). It demonstrated that winter and spring are the best seasons for fog harvesting and that the 1997 El Niño created conditions that were particularly favourable to fog formation. Coastal areas are also good for harvesting fog, although a 2001 survey using remote sensing also identified inland fog corridors, which could be of interest to future fog-collecting activities.

Surveys of the plant life at the Alto Patache fog oasis also showed the beneficial effects of El Niño: 45 species of plant were found growing during the El Niño of 1997-1998, compared with only 28 species during the 1998-2001 La Niña. The effects of El Niño on animal and insect life are less dramatic, as many insect species survive even in years of drastic water shortage, although three previously unknown species of beetle were discovered during the study.

Another project, funded by the European Union, was designed to regenerate the ecosystems of Lomas, Peru. It was carried out between 1996 and 2000 in Mejía, on the coast of Arequipa province. A multidisciplinary team of scientists from Chilean, Peruvian, French and Italian universities studied the area's biogeography, botany, climatology, ecology and forestry as well as its water storage and irrigation systems and the social and economic impact of the fog collection programme. Some 20 large FCDs were installed with a production capacity of 5,700 litres of water a day.

Research was aimed at establishing how effective artificially collected fog water could be in restoring vegetation, the ability of the local plants to grow by means of the water that they themselves collect from fog, and the potential for using surplus water collected from fog in subsistence agriculture and pasture management.

An experimental area of 7.5 hectares was fenced off, divided into two areas of six plots each, and planted with trees and shrubs that were irrigated using various systems. In order to assess the responses of different plants to the different systems, each plot contained 36 trees of five different species and 13 shrubs of four different species. The University of San Agustín de Arequipa now has an experimental station at the site.

The results of a similar experiment in Tenerife, the Canary Islands, showed that fog can be an important resource, both for the local human population and in the protection and conservation of flora and fauna. In the Teno Rural Park, fog-harvested water is used to irrigate the indigenous forest and by about 100 local people who raise goats and produce high-quality cheese.

Overall, these and other similar projects have shown that collecting fog water has the potential to contribute to the development or regeneration of arid areas, making them fit for wildlife and carefully managed human activities. In cost comparisons with two of the more viable alternatives for supplying water—reverse osmosis and water delivery by tanker truck—fog collection has also been found to be more economical, especially in the medium and long term.

Replicability

Fog-harvesting projects have been implemented on various scales in Chile, as outlined above; in two rural villages in Ecuador; in a Mexican fishing village; for a desert community in Namibia; in Peru for a school and an agricultural settlement; to supply a rural school in South Africa; and at Tenerife in the Canary Islands. Studies for future projects are also being carried out in the Dominican Republic, Haiti and Nepal.

Lessons learned

Fog water collecting projects need the involvement and practical support of local communities as well as their willingness to contribute to the set-up and running costs of the technology. Although the costs involved are not particularly high, they must still be met at least in part by local people, not all of whom find it easy to accept the introduction of the new technology or understand the benefits that it brings. The main challenge that the Camanchaca project faced was in this area, and the experiences of this project emphasize the importance of having a good water management system and carrying out awareness-raising activities in the community in order to ensure people's enthusiastic support.

Impact and future plans

Among the improvements that can be brought about by collecting fog are the economic benefits that an expanded water supply provides for rural communities. Because it is possible to provide 1,000 litres of water a day (400 litres for the staff and 600 litres for irrigation purposes), there are proposals to develop the Chilean Alto Patache fog oasis into a national park. Like Alto Patache, another national park, the Pampa del Tamarugal reserve, is about 65 kilometres from the city of Iquique and is able to generate income from visitors who come to see the natural landscape, plants and wildlife. Through modest admission fees and the sale of food, maps and photographs, money is being raised to pay park administrators, maintenance staff and researchers. The cost of visiting the Pampa del Tamarugal park is roughly equivalent to two cinema tickets or five packets of cigarettes, and approximately 3,000 Chilean and 15,000 foreign visitors enter the park every year. It is hoped that a similar number will also visit an Alto Patache park once it is created.

In other arid areas, the increased availability of water is of great benefit to local people. People living in desert areas consume 25 litres of water or less each day, yet the Chilean Ministry of Health considers 80 litres a day to be a healthy minimum. In the coastal municipality of Iquique, researchers calculate that fog collectors could raise the daily water supply from 16 to 40 litres per person, which would result not only in better living standards but also in more productive land, the value of which, the researchers forecast, would rise from US$300 to $3,750 per hectare once water becomes more available. Although the Iquique project has not yet been implemented, work is under way to win community support for the technology and to develop a willingness to contribute to its costs.

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